

A NEW SPECIES OF WATERLILY (*NYMPHAEA MINUTA*: NYMPHAEACEAE) FROM MADAGASCAR

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ABSTRACT

A new species of waterlily, ***Nymphaea minuta***, is described from Madagascar. It is closely related to *N. stellata* Willd. but displays a characteristic combination of morphological characters and two growth forms in its life history. The undersurfaces of the leaves are muddy-gray to brownish-violet in color, a unique feature of the taxon. *Nymphaea minuta* in nature is a dwarf with small, submerged, cleistogamous flowers. In cultivation, it exhibits two distinct growth forms: a submerged form and an emergent form with floating leaves and larger, emergent, chasmogamous flowers.

KEY WORDS: Waterlily, *Nymphaea*, Madagascar

RESUMEN

Se describe una nueva especie de lirio de agua, ***Nymphaea minuta***, de Madagascar. Está muy emparentada con *N. stellata* Willd. Pero tiene una combinación peculiar de caracteres morfológicos y dos formas de crecimiento en su ciclo vital. El envés de sus hojas es de color gris-pardo a marrón-violáceo, una característica singular del taxon. *Nymphaea minuta* en la naturaleza es una planta enana, sumergida, con flores cleistógamas. En cultivo, muestra dos formas de crecimiento diferentes: una forma sumergida y una forma emergente con hojas flotantes y flores más grandes, emergentes y casmógamas.

The senior authors' long-time interest and expertise in the cultivation, research, and identification of waterlilies has occasioned the present paper. The junior author collected seeds from Madagascar that were subsequently grown at the International Waterlily Preservation Repository in San Angelo, Texas. Upon examination of these garden-grown plants, it became apparent that the material concerned represented an undescribed taxon, the description of which follows.

Nymphaea minuta K. Landon, R.A. Edwards & P.I. Nozaic, sp. nov. (**Figs. 1–4**). TYPE: MADAGASCAR: near village of Tampolo, Coastal Forest in shaded rain pools (ca. 49° ... 26' E, 17° ... 15' S), 1 Jul 1999, P.I. Nozaic s.n. (HOLOTYPE: TEX).

Nymphaeae stellata Willd. Verdcourt similis sed differt floribus diurnalibus roseis vel albis in caulibus submersis et/vel emergentibus portatis et paginis foliorum emergentium supra viridibus infra limoso-canis vel dilute brunneolo-violaceis.

Plants rhizomatous growing horizontally, of two distinct forms: submerged and emersed. **Submerged** (underwater) **form**: leaves very thin, flaccid, ovate, the margins entire and wavy, surfaces glabrous, pustulose to wrinkled, bright green above, the veins distinct, lower surfaces medium-green with a bronze to reddish cast, the veins bright green, obvious and distinct, having 5 primary veins on each side of the midvein, the surface glabrous, pustulose to wrinkled, the sinus slightly open with some overlap near attachment to peti-

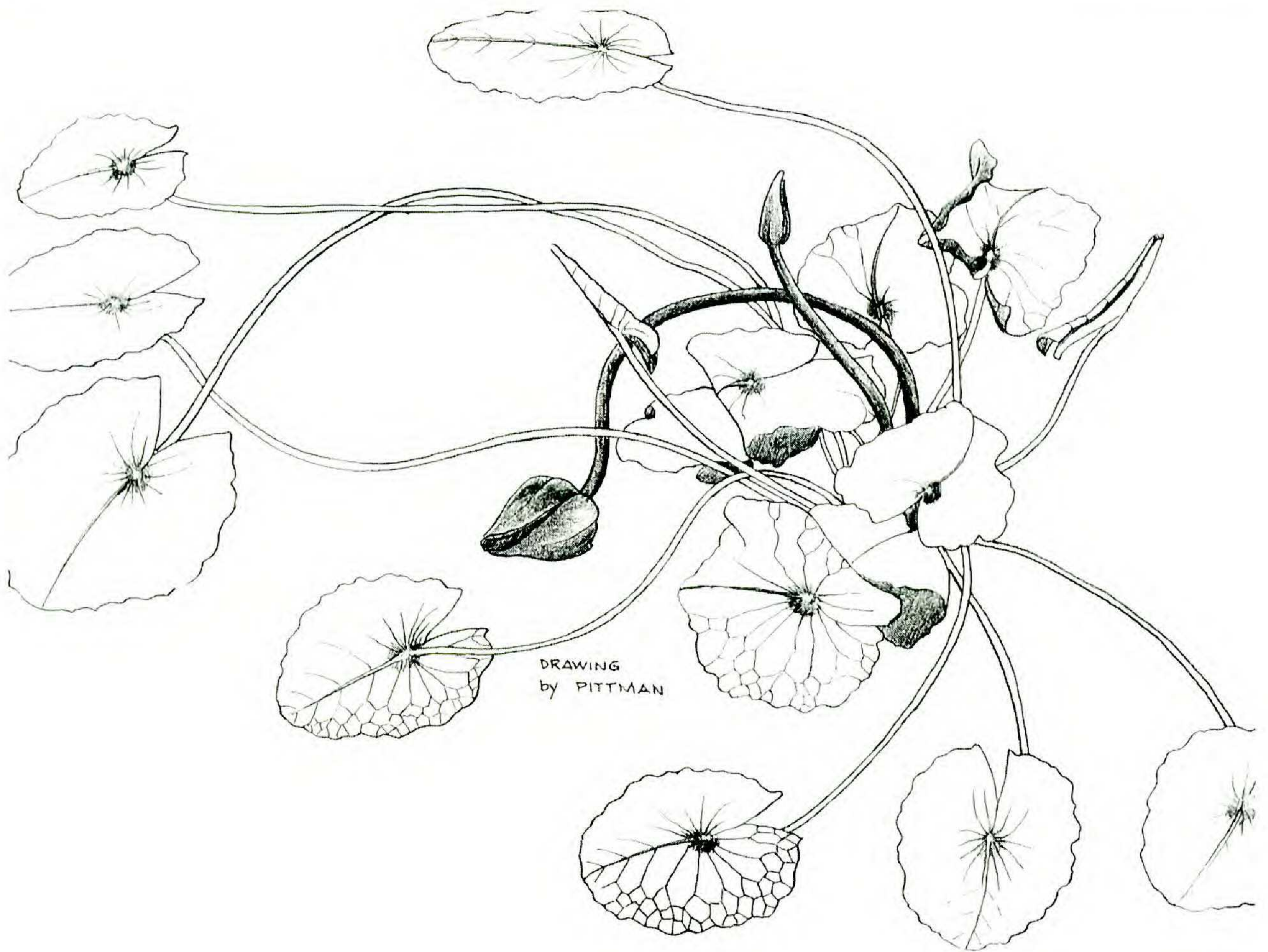


FIG. 1. *Nymphaea minima*. Plant with submerged and floating leaves (from holotype).

ole; blades mostly 10 cm \times 14 cm, the petioles usually less in length than the blade, keeping habit of plant compact and rosette-like in shape; petioles 2–3 mm wide, olive green, glabrous. Flowers produced on submerged plants rarely reaching surface, cleistogamous, rarely opening underwater; base of cleistogamous bud 0.5–2.0 cm wide, 1.5–2.0 cm long; ripe fruit to 3 cm \times 3 cm, petioles slightly curving down as fruit matures, fruit ruptures to release seed, seeds brown, oval, smooth, ca. 0.5 mm wide, at release enclosed by aril. **Emergent** (above water) **form**: leaves round, 7–12 cm wide, margins entire to slightly sinuate near sinus, sinus open with 10° to 30° angle, the surface medium-green with no other pigmentation or marking at any stage of development, lower surface pale violet with brown tones, muddy-gray appearance, bright green veins distinctive, petioles olive-green, maximum length observed 24 cm, all surfaces free of hairs or scales, overall growth pattern a circle of ca. 60 cm wide. Flowers small, 2.5–4.0 cm wide; sepals 3 to 4, somewhat longer than the petals, tips blunt-pointed, twice the width of petals at the base, sepal olive green changing to magenta at base with faint lighter stripes on outside, 7 to 9 veins, pale pink to white on inside, with faint greenish stripes. Petals 6 or 7, pale pink to white, 1.5–2.0 cm long, 0.5 cm at base, tapering to a blunt-pointed tip, with 3 main veins and 2 smaller veins on the outer edges. Stamens 8–32, shorter than petals, yellow with appendages following petal color. Anthers comprising most of the length, ripe pollen released on the 1st day, self-pollinating but also receptive to pollination by other waterlilies in the subgenus *Brachyceras*. Carpels 5 to 15, carpellary appendage a hook-like extension on outside wall of carpel, 2–3 mm long. Flowers open near noon and close by late afternoon,

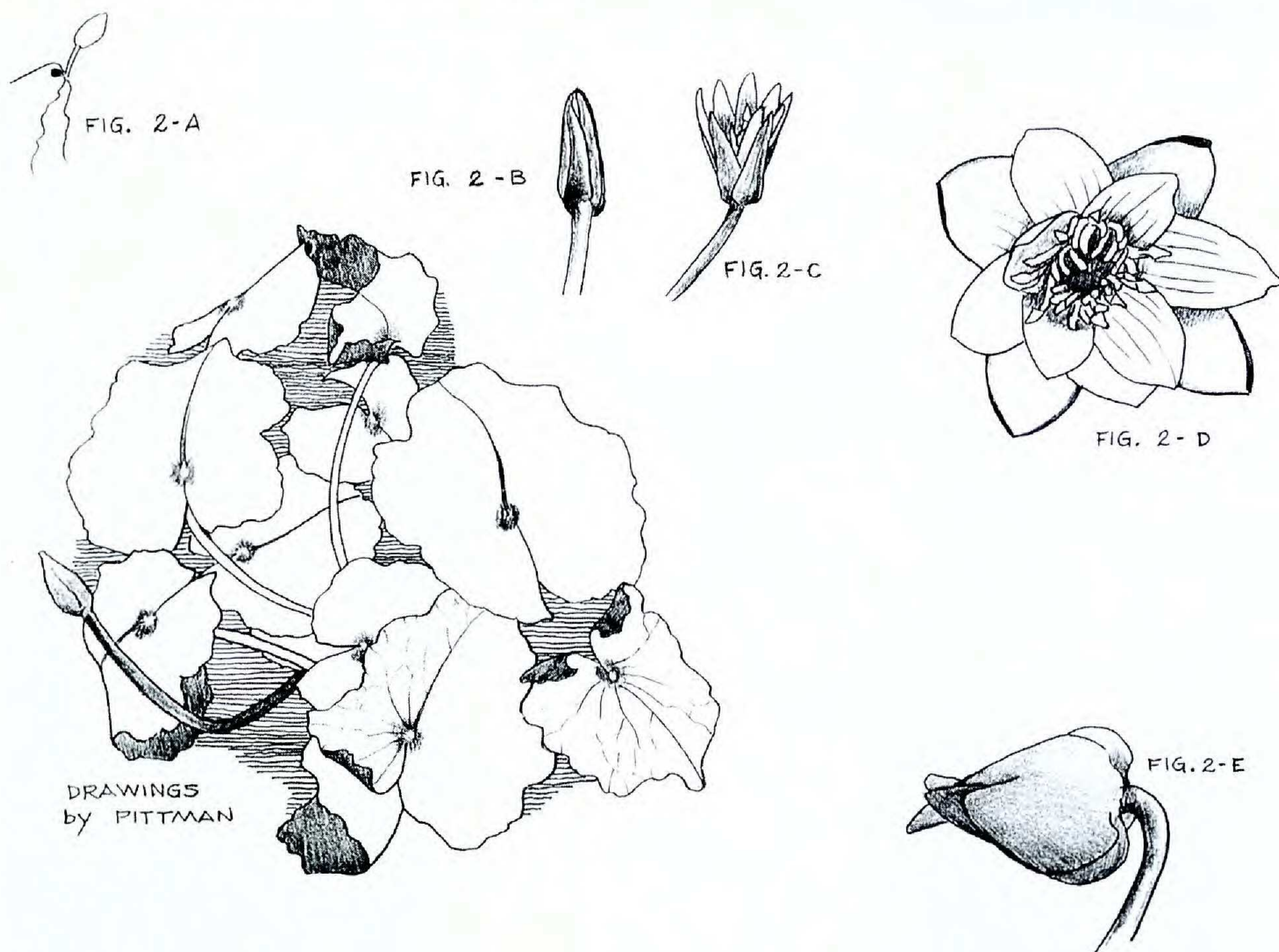


FIG. 2. *Nymphaea minuta*. A. Seedling. B. Bud. C. Submerged and or aerial flower. D. Aerial flower. E. Fruit.

submerge on third day, open to ca. 45° on first day, and slightly more on 2nd day, often do not open on 3rd day, first day flowers usually produce stigmatic fluid, peduncles curve down into water as fruit matures. Fruit orbicular, ca. 3 cm × 3 cm, rupturing to release seeds; seeds brown, smooth, oval, ca. 0.5 mm wide, enclosed by aril at release.

Distribution and Ecology.—This species is known in Madagascar only from the type locality, where it grows in jungle pools along slow-moving streams. The new species is adaptable to growing conditions other than those encountered at the type location and easily cultivated, especially in low-light environments.

Etymology.—The type plants discovered in Madagascar were all dwarf. Under typical waterlily cultivation, all plants grown remained dwarf. Only under intensive atypical cultivation regimes have larger plants been produced. This species is by far the smallest known species of *Nymphaea*. The epithet '*minuta*' was proposed by the author who discovered this species. After five years of cultivation and multiple generations for consideration, all authors believe '*minuta*' to be accurate and appropriate.

Life history of *Nymphaea minuta*

Nymphaea minuta in nature is a dwarf with a submerged habit, including small, cleistogamous, submerged flowers. These flowers rarely reach the water surface and apparently are self-fertilized without the sepals opening or exposing the petals. Various species from all subgenera of *Nymphaea* are self-pollinating, but only *N. minuta* has been documented to do this underwater. Plants of *N. minuta* in cultivation display both submerged and



FIG. 3. Top, submerged plants under artificial light in an aquarium, not submerged bud on center plant. Bottom, submerged plant grown in pond under nature conditions in a tropical climate.



FIG. 4. Clockwise from top, mature *Nymphaea minuta*, emerged form with flower, ca. 60 cm wide; close up of flower showing stigmatic disk, carpellary styles and appendages on stamen; submerged flower fully open.

emergent growth forms, the flowers are chasmogamous and vary from floating on the water to rising above the surface. Floral morphology and color remain constant in all growth forms. In response to changing environmental conditions, an individual plant can switch from one form to the other. During these transitions, intermediate phases with both floating and submerged leaves are produced, along with both emergent and submerged flowers (Fig. 2a, 2b). Light intensity and duration appear to be the controlling factor in these transitions.

In temperate latitudes, mature plants of *Nymphaea minuta* exposed to full sun will develop the emergent phase throughout the summer but revert to the submerged phase as the daylight lessens in length and intensity. The same plant often reverts back to the emergent phase the following summer.

Almost all cultivated specimens have been dwarf. However, under cultivation with fertilization and optimum conditions of light and climate, plants have been produced roughly four times larger (including flowers and all vegetative parts of the plants) than the dwarf plants first discovered. Seeds [of cleistogamous and chasmogamous flowers] remain the same size, although the number of seeds produced from the larger flowers and resulting larger fruits, increases proportionally to the rest of the plant. The number of carpels and stamen also increase at the same ratio as the size increase of vegetative parts.

Seedlings produced in full sun in late spring through mid summer will immediately grow into an emergent plant, with floating leaves and flowers at or above the water surface, typical of brachyceras tropicals. Seeds germinated in the late summer or fall will often grow in the submerged form until the following summer or until artificial light of enough intensity and duration are provided, causing the plant to transform into the emergent form. Seedlings grown in shade remain in the submerged phase but continue to grow and produce flowers and fertile fruits.

In chasmogamous flowers, stigmatic fluid is usually produced on the first day of anthesis, and ripe pollen is released. As the fruit ripens, the peduncles bend downward and fruits mature beneath the water surface.

As the plants mature, a perennial rhizome is produced. Dormant tubers have been produced in cultivation and would be expected to occur in the wild populations in ephemeral conditions.

Relationship of *Nymphaea minuta* to other species

Characters of the flowers place the new species in *Nymphaea* subgenus *Brachyceras*. The carpels are free at the sides with separate walls for each ovary. Carpellary styles are present as a small hook-like extension at the back of each carpel. The stamens have distinct appendages beyond the anthers.

Nymphaea minuta at a glance superficially more closely resembles *Nymphaea stellata* Willd. (not *N. nouchali* Burm. f., a different species, in our opinion) of tropical Asia than any other known species of waterlily. Both species display a coarsely dentate margin on floating leaves. Flowers display very low petal numbers in both species. The type habitat for *N. minuta* would also support *N. stellata* although in a stunted form. Such plants would in fact more closely mimic the dwarf nature of *N. minuta* rather than a typically proportioned *N. stellata*.

Upon closer inspection several differences between the two species would become apparent. *Nymphaea minuta* has no contrasting pigmentation upon the leaves in either

form. *Nymphaea stellata* often display slight mottling or flecks of purple pigmentation on floating leaves as they mature. The lower surface of the leaves of both species exhibit distinct and different venation and pigmentation patterns. Like most *Nymphaea* species, *N. stellata* produces submerged leaves as seedlings and emerging from dormancy, but they are diminutive, quickly deteriorate and do not represent a submerged growth form. *Nymphaea minuta* produces substantial and persistent submerged foliage, flowers and fruits, completing a full life cycle completely submerged.

Nymphaea minuta apparently will hybridize with other species and cultivars of subgenus *Brachyceras*. With *N. minuta* as pollen donor, cross-pollination was attempted on *N. micrantha* Guill. & Perr. and *N. colorata* Peter. and seed development proceeded in normal fashion. Similar results were obtained using three additional cultivars as seed parents. *Nymphaea minuta* was also used as the seed parent with crosses to hybrids with distinctive features, such as pigmentation on leaves. Further tests must be performed to see if cross-pollination actually occurred (vs. asexual seed development), but both senior authors have progeny from crosses displaying obvious hybridization. Crosses within the subgenus *Brachyceras*, with resulting progeny displaying obvious characteristics, such a pigmentation on the leaves similar to the pollen parent, provides further evidence this species should be placed within the subgenus *Brachyceras*.

Dimorphism in growth form is a rare feature in the genus *Nymphaea*. No published material exists discussing this feature with any other known subgenus of *Nymphaea*. At the International Waterlily Preservation Repository, we have another taxon in the subgenus *Brachyceras* that appears to exhibit some degree of persistent submerged growth, however, the research is incomplete.

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